

PATENT COOPERATION TREATY
PCT
INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 8085WO	FOR FURTHER ACTION	See Form PCT/IPEA/416
International application No. PCT/AU2004/000548	International filing date (<i>day/month/year</i>) 29 April 2004	Priority date (<i>day/month/year</i>) 1 May 2003
International Patent Classification (IPC) or national classification and IPC Int. Cl. ⁷ F02M 9/02, F16K 3/03		
Applicant BISHOP INNOVATION LIMITED et al		

1.	This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2.	This REPORT consists of a total of 3 sheets, including this cover sheet.
3.	This report is also accompanied by ANNEXES, comprising: <div style="margin-left: 20px;"> a. <input checked="" type="checkbox"/> (sent to the applicant and to the International Bureau) a total of 7 sheets, as follows: <div style="margin-left: 20px;"> <input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions). <input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box. </div> </div> <div style="margin-left: 20px;"> b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions). </div>
4.	This report contains indications relating to the following items: <div style="margin-left: 20px;"> <input checked="" type="checkbox"/> Box No. I Basis of the report <input type="checkbox"/> Box No. II Priority <input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability <input type="checkbox"/> Box No. IV Lack of unity of invention <input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement <input type="checkbox"/> Box No. VI Certain documents cited <input type="checkbox"/> Box No. VII Certain defects in the international application <input type="checkbox"/> Box No. VIII Certain observations on the international application </div>

Date of submission of the demand 9 December 2004	Date of completion of the report 6 June 2005
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer R. SUBBARAYAN Telephone No. (02) 6283 2377

Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1 (b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:
- ☐ the international application as originally filed/furnished
- ☒ the description:
- pages 1-2 as originally filed/furnished
 - pages* 3-4 received by this Authority on 25 May 2005 with the letter of 24 May 2005
 - pages* 5-7 received by this Authority on 9 December 2004 with the letter of 9 December 2004
- ☒ the claims:
- pages as originally filed/furnished
 - pages* as amended (together with any statement) under Article 19
 - pages* 8-9 received by this Authority on 25 May 2005 with the letter of 24 May 2005
 - pages* received by this Authority on with the letter of
- ☒ the drawings:
- pages 1/4-4/4 as originally filed/furnished
 - pages* received by this Authority on with the letter of
 - pages* received by this Authority on with the letter of
- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to the sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to the sequence listing (*specify*):

* If item 4 applies, some or all of those sheets may be marked "superseded."

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims 1-9	YES
	Claims	NO
Inventive step (IS)	Claims 1-9	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-9	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

None of the documents cited in the International Search Report discloses a rotary valve internal combustion engine comprising a rotary valve and a throttle valve adjacent the inlet port of the rotary valve, wherein the throttle valve comprises an aperture and a plurality of coplanar plates to variably open and close the aperture, the central region of the aperture is unobstructed to axial fluid flow in both open and closed configurations.

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3

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in the main air/fuel intake duct of an engine. Tubular elastic material is transversely acted upon by at least one pair of movable blades choking the elastic material in a perpendicular direction relative to the axis, thereby forming a constriction and throttling action. Like the above mentioned slide throttle valve, this type of throttle forms an unobstructed "full open" throttle condition, but disadvantageously sacrifices space similar to both butterfly and slide valves. Furthermore, the durability of the elastic material would be questionable, especially when the vacuum pressures of an internal combustion engine are considered.

- 10 The present invention seeks to provide a throttle valve for a rotary valve internal combustion piston engine that ameliorates at least some of the problems of the prior art.

SUMMARY OF INVENTION

- 15 The present invention consists of a rotary valve internal combustion piston engine comprising a rotary valve rotatable within a bore in a cylinder head and a throttle valve adjacent to the inlet port of said rotary valve, characterised in that said throttle valve comprises an aperture adapted to be variably opened and closed between a first fully opened configuration and a second near closed configuration, said aperture being variably opened and closed by a plurality of coplanar plates mounted about the periphery of said aperture and movable towards the central region of said aperture, and at said first fully opened configuration and said second near closed configuration, the central region of said aperture is unobstructed to axial fluid flow.

Preferably each of said plates is pivotally mounted.

- 25 Preferably the overall length of said throttle valve is small compared to the diameter of said aperture.

Preferably each said plate is beak shaped having a concave edge and a convex edge meeting at a tip.

- 30 Preferably said concave and convex edges are substantially equal in radius of curvature.

Preferably movement of said plurality of coplanar plates is actuated by an actuator ring to move said plates simultaneously.

Preferably said aperture is substantially circular.

- 5 Preferably said engine further comprises a fuel delivery means adapted to deliver fuel into the air before it passes through said throttle valve.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a cross-sectional view of a prior art butterfly throttle valve located near the inlet port of a rotary valve engine.

- 10 Fig. 2 is a cross-sectional view of a throttle valve of the present invention located near the inlet port of a rotary valve engine.

Fig. 3 is an elevational view of the throttle valve shown in Fig. 2 in a fully open configuration.

- 15 Fig. 4 is an elevational view of the throttle valve shown in Fig. 2 in a two-thirds open configuration.

Fig. 5 is an elevational view of the throttle valve shown in Fig. 2 in a one-third open configuration.

Fig. 6 is an elevational view of the throttle valve shown in Fig. 2 in a near closed configuration.

BEST MODE OF CARRYING OUT THE INVENTION

Fig. 1 depicts a prior art butterfly throttle valve 8 located on a rotary valve internal combustion piston engine comprising a cylinder head 2, cylinder bore 3, rotary valve 4 and a piston 5. Rotary valve 4 having an inlet port 6 in fluid communication with cylinder intake 13. A disadvantage associated with throttle valve 8 is that if it is located too close to the cylinder intake 13, the fluid flow may be misdirected by butterfly plate 7, and thereby impede efficient combustion of the air/fuel mix in cylinder bore 3.

Fig. 2 depicts a throttle valve 1, located on a single cylinder rotary valve internal combustion piston engine comprising a cylinder head 2, cylinder bore 3, rotary valve 4 and piston 5. Rotary valve 4 having an inlet port 6 in fluid communication with cylinder intake 13. Throttle valve 1 allows fuel/air mix into the cylinder bore (combustion chamber) 3 subject to the angular position of rotary valve 4.

Throttle valve 1 is mounted to inlet port 6 utilising a flange mounting means (not shown). The length L of throttle valve 1 is substantially smaller than the valve aperture diameter D. As length L is small relative to diameter D, it minimises the distance between cylinder intake 13 and the air intake opening (not shown).

Figs. 3-6 show throttle valve 1 in four different opening configurations, "fully opened", "two-thirds open", "one-third open" and "near closed". Throttle valve 1 has six coplanar "beak shaped" plates 10 disposed about the outside of the periphery of circular aperture 9. Each plate 10 has a tip 19, a concave edge 20, and a convex edge 21. The radius of curvature of each concave edge 20 and convex edge 21 is substantially equal to the radius of curvature of the periphery of circular aperture 9.

Each plate 10 is pivotally mounted about a respective fixed pin 14. The fixed pins 14 are circumferentially equally spaced apart and mounted to an annular mounting plate 15.

Each plate 10 has an arcuate slot 16 and short straight slot 17 and is constrained to pivotal movement about its respective fixed pin 14, with its arcuate slot 17 constraining the magnitude of rotation.

- 5 An actuator ring 11 has six actuator pins 18 fixed thereto and are circumferentially equally spaced apart to each other. Each actuator pin 18 is engaged with a respective straight slot 17 of a plate 10. Rotational movement of actuator ring 11, as shown by arrow A, simultaneously moves all six plates 10 about their respective fixed pins 14, such that tip 19 of each plate 10, moves inwardly into circular aperture 9 progressively closing valve 1.
- 10 Movement of "beak shaped" plates 10 varies the state of throttle valve 1 from a "fully open configuration" (see Fig. 3) to a "near closed configuration" (see Fig. 6). In the "near closed configuration", a small substantially hexagonally shaped unobstructed central region 12 of the aperture 9 is provided to allow enough air/fuel mix to maintain the engine at an idle state. Fig. 4 depicts valve 1 in a two-thirds open configuration, and Fig. 5 depicts valve 1 in a one-third open configuration. Alternatively, "near closed configuration" may represent a situation wherein central region 12 is minimised and the idle state is maintained by the throttle valve 1 being slightly opened, thereby allowing idle air/fuel mix flow between each of the plates 10.
- 20 Rotational movement of actuator ring 11 in a direction opposite to arrow A, will progressively open valve 1. In the fully open configuration of valve 1 as shown in Fig. 3, all six plates 10 withdraw from aperture 9 such that their respective concave edges 20 align with the outer circular periphery of aperture 9. In this fully open configuration, there is no obstruction to air/fuel flow.
- 25 An advantage of throttle valve 1 of the above described embodiment is that it provides a low obstruction, non-directed intake path that is not achievable with prior art butterfly valves, whilst promoting fuel/air mixture. It also has the advantage of compact space configuration, not achievable with prior art slide valves and that of the valve described in US Patent No. 5,662,086 (Piccinini).
- 30 This makes the above-described embodiment of the present invention, advantageous for high-speed engines, such as competition engines.

Another advantage of this embodiment is that all six plates 10 are co-planar and do not overlap. As such, they are not prone to binding and seizure that occurs with conventional "iris diaphragm" type valves.

5 It should be understood that the reciprocal rotation of actuator ring 11 to variably open and close throttle valve 1, may be achieved by any suitable actuation mechanism, such as a biased mechanical cable, hydraulic or electric motorised actuator.

10 It should also be understood that in another not shown embodiment, plates 10 may have concave and convex edges having radii of curvature that are not substantially equal to that of the circular aperture 9. In such an embodiment plates 10 may have to withdraw past the outer periphery of the aperture 9 to allow an unobstructed "fully open configuration" of valve 1.

15 In the above described embodiment, the fuel delivery means is not shown. It should be understood that the fuel delivery means may deliver fuel before or after throttle valve 1. In the case of a direct injection internal combustion engine, throttle valve 1 may be used only for air.

20 In the embodiment where the fuel delivery means delivers fuel and air before throttle valve 1, it should be understood that tip 19, and concave and convex edges 20, 21 of each plate 10, may assist in the mixing of the fuel and air when throttle valve 1 is partly opened, such as depicted in Figs. 4 and 5.

It should also be understood that whilst the above described embodiment of the present invention is particularly suited to use with a high speed rotary valve competition piston engine, the throttle valve of the present invention may be used with any internal combustion piston engine.

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